# Aviation Investigation Final Report

| | | | |
|---|---|---|---|
| **Location:** | FALFURRIAS, Texas | **Accident Number:** | FTW95LA239 |
| **Date & Time:** | May 30, 1995, 14:10 Local | **Registration:** | N1502L |
| **Aircraft:** | BELL 47G-5 | **Aircraft Damage:** | Substantial |
| **Defining Event:** | | **Injuries:** | 1 None |
| **Flight Conducted Under:** | Part 91: General aviation - Other work use | | |

## Analysis

AS THE HELICOPTER WAS BEING MANEUVERED AT LOW ALTITUDE TO HERD CATTLE, THE TAILROTOR DRIVE LOST CONTINUITY. THE PILOT REPORTED THAT DIRECTIONAL CONTROL WAS LOST, AND THAT HE EXECUTED AN AUTOROTATION INTO A CONFINED AREA. DURING DESCENT/LANDING, THE MAIN ROTOR BLADE STRUCK A TREE, AND THE HELICOPTER ROLLED ONTO ITS RIGHT SIDE. AN INVESTIGATION REVEALED EXCESSIVE WEAR ON THE TAIL ROTOR GEAR/DRIVE ASSEMBLY (TRANSMISSION OUTPUT QUILL GEAR). A METALLURGICAL EXAMINATION OF THE ASSEMBLY REVEALED THAT THE GEAR'S SHAFT (WHICH CONSTITUTED THE INNER RACEWAY OF AN ASSOCIATED CYLINDRICAL BEARING) HAD NOT BEEN CARBURIZED AS REQUIRED BY THE DESIGN MANUFACTURER. ROTATION OF THE BEARING ROLLERS OVER THE RELATIVELY SOFT SURFACE OF THE SHAFT HAD WORN A GROOVE IN THE SHAFT. THE ASSOCIATED BEARING (TAIL ROTOR DRIVE ASSEMBLY BEARING) SUBSEQUENTLY FAILED. THE GEAR AND BEARING WERE UNAPPROVED PARTS AND DID NOT CONFORM TO THE MANUFACTURER'S DESIGN SPECIFICATIONS. THE SOURCE OF THE UNAPPROVED PARTS WAS NOT DETERMINED, ALTHOUGH PACKAGING OF THE PARTS WAS REPORTED TO RESEMBLE THAT OF THE MANUFACTURER. PART NUMBERS WERE FOUND ON THE GEAR AND BEARING, SIMILAR TO AUTHORIZED PARTS, ALTHOUGH A DIFFERENT METHOD OF MARKING (ETCHING) WAS USED TO MARK THE GEAR.

## Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: INADVERTENT INSTALLATION OF AN UNAPPROVED PART (TAIL ROTOR GEAR/DRIVE ASSEMBLY), THAT BECAME EXCESSIVELY WORN SINCE IT DID NOT CONFORM TO THE MANUFACTURER'S SPECIFICATION, RESULTING IN FAILURE OF THE ASSOCIATED TAIL ROTOR BEARING (ALSO AN UNAPPROVED PART), LOSS OF CONTINUITY (DISCONNECT) OF

THE TAIL ROTOR DRIVE SYSTEM, AND A FORCED AUTOROTATION INTO AN AREA WITH TREES.

## Findings

Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation: MANEUVERING

Findings
1. (C) MAINTENANCE,INSTALLATION - INADVERTENT USE
2. (C) ROTOR DRIVE SYSTEM,TAIL ROTOR DRIVE SHAFT COUPLING - UNAPPROVED PART
3. (C) MATERIAL INADEQUATE
4. (C) ROTOR DRIVE SYSTEM,TAIL ROTOR DRIVE SHAFT COUPLING - WORN
5. ROTOR DRIVE SYSTEM,TAIL ROTOR DRIVE SHAFT BEARING - UNAPPROVED PART
6. (C) ROTOR DRIVE SYSTEM,TAIL ROTOR DRIVE SHAFT BEARING - FAILURE,TOTAL
7. (C) ROTOR DRIVE SYSTEM - DISCONNECTED
---

Occurrence #2: FORCED LANDING
Phase of Operation: EMERGENCY DESCENT/LANDING

Findings
8. AUTOROTATION - INITIATED - PILOT IN COMMAND
---

Occurrence #3: IN FLIGHT COLLISION WITH OBJECT
Phase of Operation: LANDING - FLARE/TOUCHDOWN

Findings
9. OBJECT - TREE(S)
---

Occurrence #4: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: DESCENT - UNCONTROLLED

## Factual Information

On May 30, 1995, at 1410 central daylight time, a Bell 47G-5, N1502L, sustained substantial damaged while maneuvering near Falfurrias, Texas. The commercial pilot was not injured. The helicopter was being operated as a business flight by Tiller Helicopter Service under Title 14 CFR Part 91. Visual meteorological conditions prevailed for the local cattle herding flight and a flight plan was not filed.

During interviews and on the Pilot/Operator Report, the operator reported that the pilot had been working cattle on the Felix Tapp ranch for approximately 5.5 hours when he stopped for lunch and refueling of the helicopter. Upon departure, he had one pasture where he needed to finish the roundup of the cattle. Approximately 45 minutes into the flight, at 50 to 60 feet above the ground, the "helicopter didn't feel right." The pilot landed the helicopter in the mesquite thicket area and checked the instruments, magnetos, tailboom, drive shaft, and tailrotor. Following a subsequent 45 seconds to 1 minute hover, the helicopter checked "ok no vibration" and the pilot continued the flight over the mesquite thicket to the edge of the pasture.

Upon maneuvering at the outer perimeter of the pasture, as the pilot leveled the helicopter from a right turn, the helicopter started spinning to the right and "application of the left pedal had no effect." The pilot initiated an autorotation from 75 feet above the ground into a confined area with a left turn to clear the mesquite trees. As the pilot pulled in collective, the helicopter started spinning, the main rotor blade struck a tree, the skids touched the ground, and the helicopter rolled to the right impacting the ground.

The operator recovered the helicopter from the ranch. Following his examination the separated tailrotor drive shaft was reported to the Federal Aviation Administration. The Federal Aviation Administration inspector examined the helicopter and secured the gear and bearing for metallurgical examination by the NTSB.

According to the operator, the bearing P/N 47-620-929-1 was ordered (invoice copy enclosed) on December 23, 1994, from Helicopter Spares, Inc., of Bridgeport, Pennsylvania. Following installation of the bearing, the helicopter was returned to service by the operator's maintenance personnel on January 29, 1995.

During a telephone conversation, conducted by the investigator-in-charge, with Mr. Jack Carson, President of Helicopter Spares, the bearing shipped was P/N 47-620-929-1 as shown on the invoice. Mr. Carson further stated that their parts are received and placed in a bin prior to filling the customer's order. Helicopter Spares does not run a quality control check on the incoming parts as the parts are received in Bell packaging with accompanying documentation from Horshan Valley Aviation of Horshan, Pennsylvania.

During a telephone conversation, conducted by the investigator- in-charge, Mr. Hoyt Bangs of Horshan Valley Aviation, stated that they receive the parts directly from Bell Helicopter Textron, Inc., of Fort Worth, Texas. Mr. Bangs further reported (invoice copies enclosed) that the bearing P/N 47-629-929-1 was invoiced from Bell Helicopter Textron on November 9, 1995, and shipped to Helicopter Spares, Inc., on November 21, 1994.

On August 10, 1995, the bearing and gear components from Model 47G-5, S/N 7945 were examined by the investigator-in-charge and a representative of Bell Helicopter at Hurst, Texas. The bearing, received by the operator from Helicopter Spares, as P/N 47-620-929-1 showed identity "NDH1303T17." It was determined that the bearing was P/N 1303TS17 with the marking of "1303T17" on the bearing being the part number for the outer race only. The manufacturer representative stated that the Hyatt Roller Bearing (General Motors Corporation at Sandusky, Ohio) assembly P/N 1303TS17 is the "only qualified bearing and manufacturer source for Bell P/N 47-620-605-1." This P/N was replaced by P/N 47-620-929-1 by Alert Service Bulletin 47-80-6 issued in May 15, 1980, by Bell Helicopter. Bearing P/N 1303TS17 is not part of the type design for the Model 47G-5 civilian helicopter and is considered an unapproved part. On the enclosed statement, dated December 8, 1995, the Bell Helicopter representative reported that the last sale of a bearing P/N 47-620-605-1 was in 1972.

During a telephone interview, conducted by the investigator-in- charge, Mr. Chuck Kromer of Del Phi Chassis (formerly Hyatt Roller Bearing) at Sandusky, Ohio, stated that the company stopped manufacturing bearing P/N NDH1303T17 in 1987.

The gear from the fan drive assembly was identified with an etched P/N 47-620-568-3-A. Parts produced by or for Bell are "not marked by this method." Bell helicopter's design drawing for the gear indicates P/N 47-620-568-3 with a black oxide finish per BPS 4084. Visual examination of the gear did not indicate a black oxide finish and the gear was forwarded to the NTSB metallurgists. The gear could not be identified as conforming to the type design data and is considered an unapproved part. The source and maintenance history for the gear P/N 47-620-568-3-A could not be determined.

The Materials Laboratory NTSB Metallurgist (enclosed report) visual and metallographic examination of the gear revealed that a portion of the gear's shaft that constitutes the inner race for the cylindrical bearing was not carburized. The inner race area of the shaft contained an "approximately 0.31 inch long groove where material appeared to be worn away." The microstructure at the surface of the gear's shaft was "heavily deformed with the most severe grain flow in the grooved area." The rollers from the bearing were "heavily deformed and discolored by heat tinting." Pieces of the bearing retainer revealed features "consistent with overstress separations."

The gear and bearing components were released to the owner.

## Pilot Information

| | | | |
|---|---|---|---|
| **Certificate:** | Commercial | **Age:** | 40,Male |
| **Airplane Rating(s):** | None | **Seat Occupied:** | Left |
| **Other Aircraft Rating(s):** | Helicopter | **Restraint Used:** | |
| **Instrument Rating(s):** | None | **Second Pilot Present:** | No |
| **Instructor Rating(s):** | None | **Toxicology Performed:** | No |
| **Medical Certification:** | Class 2 Valid Medical--w/ waivers/lim | **Last FAA Medical Exam:** | October 7, 1994 |
| **Occupational Pilot:** | Yes | **Last Flight Review or Equivalent:** | |
| **Flight Time:** | 5664 hours (Total, all aircraft), 5664 hours (Total, this make and model), 5647 hours (Pilot In Command, all aircraft), 40 hours (Last 90 days, all aircraft), 23 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft) | | |

## Aircraft and Owner/Operator Information

| | | | |
|---|---|---|---|
| **Aircraft Make:** | BELL | **Registration:** | N1502L |
| **Model/Series:** | 47G-5 47G-5 | **Aircraft Category:** | Helicopter |
| **Year of Manufacture:** | | **Amateur Built:** | |
| **Airworthiness Certificate:** | Normal | **Serial Number:** | 7945 |
| **Landing Gear Type:** | Skid | **Seats:** | 3 |
| **Date/Type of Last Inspection:** | January 25, 1995 Annual | **Certified Max Gross Wt.:** | 2850 lbs |
| **Time Since Last Inspection:** | 60 Hrs | **Engines:** | 1 Reciprocating |
| **Airframe Total Time:** | 11078 Hrs | **Engine Manufacturer:** | LYCOMING |
| **ELT:** | Not installed | **Engine Model/Series:** | VO-435-B1A |
| **Registered Owner:** | W. J. TILLER | **Rated Power:** | 260 Horsepower |
| **Operator:** | | **Operating Certificate(s) Held:** | None |
| **Operator Does Business As:** | TILLER HELICOPTER SERVICE | **Operator Designator Code:** | |

## Meteorological Information and Flight Plan

| | | | |
|---|---|---|---|
| **Conditions at Accident Site:** | Visual (VMC) | **Condition of Light:** | Day |
| **Observation Facility, Elevation:** | | **Distance from Accident Site:** | |
| **Observation Time:** | | **Direction from Accident Site:** | |
| **Lowest Cloud Condition:** | Clear | **Visibility** | 6 miles |
| **Lowest Ceiling:** | None | **Visibility (RVR):** | |
| **Wind Speed/Gusts:** | 10 knots / | **Turbulence Type Forecast/Actual:** | / |
| **Wind Direction:** | 135° | **Turbulence Severity Forecast/Actual:** | / |
| **Altimeter Setting:** | | **Temperature/Dew Point:** | 32°C |
| **Precipitation and Obscuration:** | No Obscuration; No Precipitation | | |
| **Departure Point:** | | **Type of Flight Plan Filed:** | None |
| **Destination:** | | **Type of Clearance:** | None |
| **Departure Time:** | 13:00 Local | **Type of Airspace:** | Class G |

## Airport Information

| | | | |
|---|---|---|---|
| **Airport:** | | **Runway Surface Type:** | |
| **Airport Elevation:** | | **Runway Surface Condition:** | |
| **Runway Used:** | 0 | **IFR Approach:** | None |
| **Runway Length/Width:** | | **VFR Approach/Landing:** | Forced landing |

## Wreckage and Impact Information

| | | | |
|---|---|---|---|
| **Crew Injuries:** | 1 None | **Aircraft Damage:** | Substantial |
| **Passenger Injuries:** | | **Aircraft Fire:** | None |
| **Ground Injuries:** | N/A | **Aircraft Explosion:** | None |
| **Total Injuries:** | 1 None | **Latitude, Longitude:** | 27.219215,-98.140319(est) |

## Administrative Information

| | |
|---|---|
| **Investigator In Charge (IIC):** | Smith, Joyce |
| **Additional Participating Persons:** | DESIDERIO S AGUILAR; SAN ANTONIO , TX |
| **Original Publish Date:** | February 27, 1996 |
| **Last Revision Date:** | |
| **Investigation Class:** | Class |
| **Note:** | |
| **Investigation Docket:** | https://data.ntsb.gov/Docket?ProjectID=19449 |